logging operations. The Trinity, Neches, and Sabine averaged from 6 to 8 feet higher than during March, and in some places these streams were nearly bank full. The Brazos, Colorado, and Guadalupe averaged nearly 2 feet higher. The flow of the Rio Pecos was also better than during the preceding month, but that of the Rio Grande was less. There was, however, ample water for irrigation purposes.

MISCELLANEOUS.

Harveys Upper Ranch, N. Mex.—A great amount of snow remains in the gulches and on the north sides of the mountains, and it seems that there will be an abundance of water.

Jemez Springs, N. Mex.—The frost of the 13th does not seem to have damaged even the apricots, which seldom escape. There are prospects of a heavy fruit crop, if there be no bad frosts in May.

Placitas, N. Mex.—There is no snow at the ranch, but higher up in the mountains it is from 1 to 2 feet deep. It is, however, soft and melting.

Rosedale, N. Mex.—There has been an abundance of water so far. The snow is 3 feet deep on the north sides of the mountains and in sheltered places. Grass and forage are better now than they have been for many years at this time.

Tajique, N. Mex.—There is more water in the mountains than there has been for the past three years.

Tijeras Canyon, N. Mex.—The nights continue cold and ice frequently forms, but there is little damage to fruit and vegetation. There is plenty of snow in the Sandia Mountains.

Big Springs, Tex.—Farmers claim that the prospects are better at this time than they have ever been in this county.

Duval, Tex.—The precipitation for April was the heaviest in that month since 1884, except in April, 1900, when it was 9.34 inches.

Eastland, Tex.—Crops in general are in good condition. Small grain is affected with rust to a slight extent. Most of the cotton is up or coming up.

Georgetown, Tex.—The rainfall during the month was unusually large, and the ground is wetter than it has been for years.

Grapevine, Tex.—There was a severe storm from the northwest on the 18th. The wind blew at an estimated velocity of 55 miles per hour, and the hailstones were as large as goose eggs and destroyed the corn in the path of the storm.

Jewett, Tex.—The month has been very wet and the rainfall was just slow enough to keep the farmers from work.

Lagrange, Tex.—Farmers are complaining of too much rain and that the grass is taking their crops.

Lubbock, Tex.—The weather has been favorable during the month, notwithstanding a hailstorm during the night of the 23d–24th, which did considerable damage to fruit and small plants.

Post City, Tex.—A severe wind and hailstorm from the southeast occurred during the night of the 23d.

Sealy, Tex.—The rainfall for the month of April was exceedingly heavy as compared with that of the last 12 months. Farmers are complaining that the ground is too wet for field work and that the grass is getting over their cotton and corn. Some damage was caused by a hailstorm on the 30th.

PROTECTION AGAINST FROST.

By E. W. GRUSS, Houston Heights, Tex.

The freeze of January, 1911, has given the fruit and truck industry of south Texas a setback, from which to recover will probably require several years. Tens of thousands of Satsuma orange trees, ranging in age from those just transplanted to those already in bearing, were either killed absolutely or, in the case of the older, the bearing time was delayed for a year. This freeze has shown, furthermore, that our people are, in many instances, ready to invest in anything which has been represented to them as yielding extraordinary returns for a comparatively small expenditure of capital and labor. Against all sound judgment, many newcomers have invested their hard-earned savings in land of which they knew naught, and planted the land to crops to the successful production of which they had no actual knowledge. That the citrus and truck industries will ultimately triumph in this section of Texas there is no doubt, but the methods employed at the present to accomplish this result, especially that of protection from frost, must undergo radical and far-reaching changes.

Smudging beneficial.—Those orchards in which smoke protection was given during the freeze referred to above proved the efficacy of the smudge pot. This method of protection, however, was only in the experimental stage, and is therefore subject to great improvement. The chief defects to be overcome are the thinness of the smoke produced by the fuel now in use and the lack of windbreaks.

Dense smudge.—Instead of the light smoke resulting from the burning of crude petroleum, a dense, heavy, moist smoke should be caused to roll through the orchard. Such a smoke could be produced by a dry fuel fire passing through some wet or moist material, as, for instance, wet hay or straw, or moist manure or sawdust. The evaporation of the water in the smudging material will increase the humidity of the air in the orchard. Receding from the point of origin, the vapor will be condensed and the latent heat set free. The condensed vapor, acting as a damper upon the fires, will cause them to burn slowly, thus producing a very heavy, fog-like, all-enveloping smudge. If the wind checks are properly distributed throughout the grounds the smudge will move slowly, and there will be sufficient obstruction to the average "norther," the source of greatest trouble in south Texas, to prevent a large percentage of the vapor and heat contents of the smudge from passing beyond the confines of the area to be protected.

Windbreaks.—Experience has shown that windbreaks must be planted to assist in warding off frost. Satsuma trees grow low, and in order to break the force of the wind more effectually, the windbreaks should be composed of evergreens with well-developed tops, and growing to about twice the height of the Satsuma. These windbreaks should be planted throughout the orchard and be as numerous as may be consistent with the development of the Satsumas.

Protecting truck crops.—Truck, though commercially of lower value than citrus fruit, is of vastly higher importance from a utilitarian point of view. Hence, protection of every nature extended to the trucker and his crops is a protection to the nation's food supply.

Trucking in the South is profitable only, as a rule, if the produce can be marketed from December 1 to May 1 of the following spring. Before Thanksgiving the north-

ern consumer still uses the produce stored in cellar and pit at home, but after that time the demand for fresh southern vegetables increases from day to day until about May 1, when the more centrally located States appear on the market with their produce and the demand for southern shipments largely ceases, in consequence of which fact they are no longer profitable. Clearly, then, it is to the best interest of the southern trucker to protect his growing crops against destruction by frost.

General precautions.—In providing protection for truck crops the following general precautions should be observed: 1. Every farmer should study the formation or "the lay" of his farm. Cold air is heavier than that of a higher temperature, and consequently, like water, it always seeks the lowest level. This accounts for the fact that a farm located in a dale may be visited by a frost, while one adjoining and lying but a few feet higher may escape such visits. 2. Planting in low places should be avoided as far as practicable. 3. Planting should be so made that the vital parts of the plants may be protected by banking. If the furrows can be laid off to run east and west, the northern half of the ridge may be thrown up higher than the opposite side. 4. *Telephones should be installed and the Weather Bureau's forecasts arranged for. These forecasts should reach the farms as early as possible so as to permit the making or perfecting of preparations.* 5. Last, but not least, the farmer should be ready to act at a moment's notice, and learn to utilize the forecast of the Weather Bureau, that he may know what temperature to expect within the next 12 to 24 hours.

Specific precautions.—In addition to the foregoing general precautions some specific method should be adopted with the view of guarding against the destruction of the crop by the cold. If these methods are considered with respect to the amount of money to be expended in putting them in operation, they would appear as follows: 1. Covering the plants with soil. 2. Covering the plants with hay or straw. 3. Covering by turning mulch upon the plants. 4. Mats of material suitable for the object in view. 5. Covering with slatted mats. 6. Sheds with solid or slatted roofs. 7. Smudge. 8. Flooding. 9. Spraying. 10. Spraying and smudging. In point of practicability the ninth method doubtlessly takes precedence over all others, flooding ranking second.

Flooding and spraying.—Flooding and spraying are the only two methods by which the farmer can utilize the same plant which gives him crop insurance in the time of drought, for crop insurance against frost.

In all instances of protection against frost it is of the utmost importance that the safeguards be thrown out with the greatest possible dispatch after the danger signal has been sounded. Hence it is necessary that an abundance or even superabundance of water be quickly available. This demand can be met by one or more earthen tanks which can be constructed by the farmer himself during the time when field work is light or at a standstill. A cylinder pump operated by air power can be utilized to fill the tanks, while a centrifugal pump operated by a gasoline or electric motor will flood the field in a very short time. If spraying is resorted to for giving the needed protection, it will be necessary to provide for a standpipe or elevated tank of large capacity. The water supply should be ample and the capacity of the pump large enough to keep the water at the same level in the reservoir or even raise it during the period the sprayer is in operation.

Apparatus.—The spraying apparatus may consist of a number of upright pipes from 20 to 30 feet high, to the top of each of which is affixed a whirling nozzle or some other contrivance which will successfully distribute the water over a larger area than would be possible with a single-stream nozzle. Another plan would be to lay lines of pipe over the area to be protected. These pipe lines should be fixed to posts 6, 8, or 10 feet high, and be provided with numerous holes drilled at regular intervals, into which good spraying nozzles should be fitted.

When to operate.—As soon as the danger signal has been sounded the water should be turned on. Whichever plan of spraying is preferred, care should be taken that the distribution of the spray be perfect and simultaneous if possible over the entire area under protection. The sprayer should remain in operation until the danger of frost for the time being has passed, or until a crust of ice has been formed on the plants, thus protecting them most perfectly.

In the event frost has already entered the plants, spraying is the best method to prevent serious injury to the plant structure. In the process of freezing the protoplasm of the plant cells contracts, the water is expelled and enters the intercellular spaces where it freezes. Observations have shown that if the sky be leaden, or if the day following the frost be a rainy one, the percentage of plants killed is comparatively low. On the other hand, if the sky be clear, it will be but a matter of a few hours when everything will lie limp and dead. Obviously it is to the farmer's interest to produce conditions favorable to the resuscitation of the frozen plants. This may be accomplished by starting the sprayer some time before sunrise. The moisture thus applied will admit of but a gradual rise in the temperature, the frost is drawn out of the plant gradually, the protoplasm will again absorb the water and, barring some less serious "frost burns," the plant will be restored to life. *Spraying must continue until the plant is completely thawed out.* Snow and ice are very poor conductors of heat, consequently in covering the area planted to winter truck with a coating of ice, the farmer does naught but imitate nature when she covers vegetation with a blanket of snow. *The chief point to be borne in mind when vegetation is frozen is that a retarded process of thawing is absolutely necessary to the saving of the frozen plants.*

That south Texas has a great future as a citrus and truck-growing section is beyond a reasonable doubt, but in order that the best results may materialize, greater efforts must be made to guard against the annually recurring losses by frost. Not until the growers make provision for protection along the lines indicated will these industries become dependable resources of this great Commonwealth.